Microwave Valley Spectroscopy of Silicon Quantum Wells

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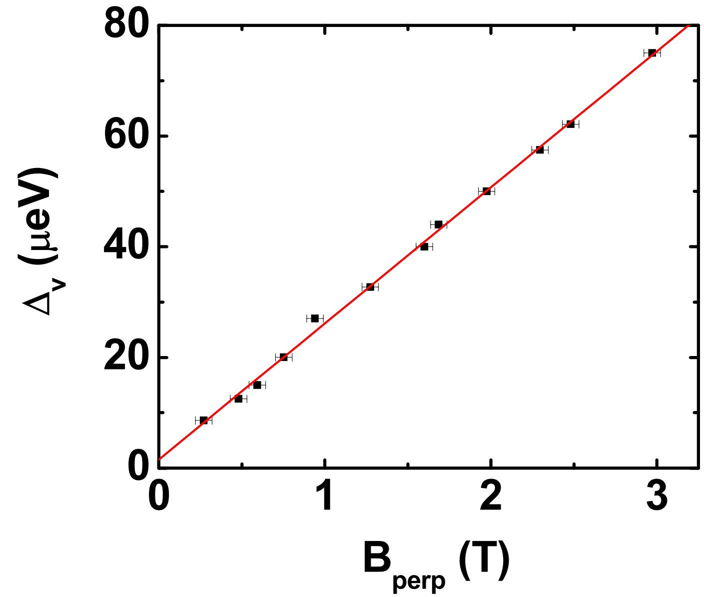
Silicon quantum wells are promising systems for semiconductor spintronics. An interesting feature of silicon is the multiple valley degeneracy in the conduction band. Strain and quantum confinement split this degeneracy.

Using microwave spectroscopy we have measured the energy gap between the two lowest valley states in high quality silicon/silicon-germanium quantum wells. The gap is found to depend linearly on applied magnetic field, a striking feature that is as yet not fully understood by theory.

The measured energy gap provides experimental demonstration that the lowest valley state is non-degenerate, a step towards silicon spintronics.



Valley splitting in a Si/SiGe quantum well showing the high linearity as a function of perpendicular magnetic field.

Srijit Goswami, J.L. Truitt, Charles Tahan, L.J. Klein, K. A. Slinker, D. W. van der Weide, S.N. Coppersmith, Robert Joynt, R.H. Blick, Mark A. Eriksson, J.O. Chu, P.M. Mooney, **cond-mat/0408389**

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Education:

Four graduate students (Srijit Goswami, Jim Truitt, Charles Tahan, and Keith Slinker) contributed to this work. Truitt will receive his Ph.D. in Fall 2004 and has accepted a position at MIT Lincoln Labs. Tahan will receive his Ph.D. in Spring 2005 and will pursue postdoctoral research in related fields. Slinker and Goswami are pursuing ongoing research towards their Ph.D.'s with the PI.

Societal Impact:

Spins in silicon have the potential to provide added function to a technologically important material. Microwave valley spectroscopy provides new information about the way in which spins will behave in silicon devices.